The Portuguese and Mathematics

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1. If we wish to analyse any matter, global or special, about Education in Portugal, we must begin by describing realistically the features of the country in what concerns the skills and qualifications of its population.

   Portugal exhibits, at the start of the 21st century, a set of indicators that place it in a very unfavourable position in relation to the overwhelming majority of the 25 countries in the European Union. Actually, Portugal comes last in most indicators relating to population skills (in the 25-64 group) and it should be noticed that (i) around 68% of the Portuguese have been at most 6 years in school (which is even less than the mandatory 9 years prescribed in the 1986 Lei de Bases); (ii) only 9% possess a higher degree; and (iii) a very small number (around 11%) have completed the full 12 years at secondary school.

   If we add to these indicators the fact that around 80% of Portuguese businessmen have been at most 9 years in school, and that 50% of the Portuguese, when asked about their interest in learning new things, give the answer that they are not interested in learning anything else in their lives, we must conclude that the situation in Portugal concerning human resources is very weak and seriously constrains the development of the country;

2. To the situation just described we must still add, as a very negative indicator of the Portuguese situation, the results obtained by Portuguese students in tests designed to compare skill levels of school pupils in different countries.

   In recent reports assessing scientific and mathematical literacy (Program for International Student Assessment - GAVE - Education Ministry - December 2000) we can read the following statements, which cast an unfavourable light on the skills of our young people:

   (a) The performance of Portuguese students was inferior to the OECD average;

   (b) Many 15-year-olds are not able to handle simple symbolic representations, or relations between representations;

   (c) They also display poor reasoning skills, as shown by the arguments they use;

   (d) They generalize situations without checking their validity;

   (e) They use everyday information to base their answers on, without this information being relevant to the problem at hand; and

   (f) They base their answers on situations clearly excluded by the conditions stated.

3. It is in this setting that we must analyse the way the Portuguese relate to the school, to knowledge, and in particular to Mathematics, which has become an "Achilles' heel" and one of the main factors in the school failure of many Portuguese young people. (It should be said, however, that this "Achilles' heel" is not a Portuguese exclusive, since in many other countries Mathematics is also a subject disliked by many students. It is enough to recall the famous US report from the early 80s - A Nation at Risk - where Mathematics appears as one of the subjects in which US students had their worst performances and greatest difficulties when going into higher education);

4. Surely there are many explaining factors for the difficult relation Portuguese students have with Mathematics. Here I would like to be very straightforward and not pretend to be an expert in a very complex matter, which has already been the object of lots of research by people who have a scientific and academic authority I do not possess. That is why this article is a mere reflection on a subject, which worries many of those who, like me, have been following educational matters for a long time. This reflection is based on my own observation of several factors which influence the bad relation between the Portuguese and mathematical logic and rigour;

5. The first of these factors is the great lack of rigour and accuracy in the everyday behaviour of the Portuguese. Whether in being on time, in describing facts, or in following traffic rules, the Portuguese became accustomed to the banality of transgression and to systematically excusing those who do not fulfil their duties and obligations.

   Mathematics requires a frame of mind, which is precisely the opposite of this behaviour. Mathematics implies absolute accuracy and a mental structure in which each "piece" connects with those nearby, forming a coherent set in which any error or deviation means a deformation incompatible with the model.

   This lack of rigour is often followed by a certain resignation of the population with respect to its mathematical knowledge. It is very common to excuse a bad mathematical performance by a child with statements like "That's no surprise, we are all like that at home";

6. The second factor has to do with a typically Portuguese attitude, which sees a connection between "luck" and "success". To many Portuguese people, someone's success is almost always attributed to exogenous factors such as "luck" and "opportunity", or, even worse, special "recommendations" or "requests". The positive results attained in life by someone are often explained by others as mere "chance" or resulting from "tricks". Seldom are they explained because the person (or the team, or the company) developed a plan of action, in which lots of time and work were invested, with commitment, effort and sacrifice.

   Mathematics is not compatible with ease or luck. To be learnt, Mathematics requires great effort and continued dedication. It is not enough to understand the concepts, it is necessary to know how to apply them, which demands time, repetition and effort, even more so when dealing with more complex subjects, where several concepts, methods or formulas come together in a web whose "design" requires great individual concentration and ability.

   Here we must mention some "theories" which view memorization and exercise repetition as anti-pedagogical methods.

   In my opinion, based on my own experience (though a little remote already), the learning of Mathematics goes beyond the understanding of concepts, methods and relations. Mathematics is a subject in which some automatisms are required, and these are acquired following a course full of trials and errors, which make us, think, experiment and test concepts, formulas and rules.

   We should also mention that Mathematics, with its difficulty, was, and still is, considered a subject of certain failure for underprivileged students. This led some "schools of thought" to try and make it less demanding for students coming from poorer backgrounds.

   This is surely a wrong interpretation of the "underprivileged" concept, whose practical consequences are too apparent nowadays to be ignored.

   In this matter we cannot and should not introduce any positive or negative discriminations. Only quality and demanding teaching can include all young people who look to education as the best way to progress and seek personal and collective fulfilment;

7. A third factor is the teaching in the first school years. Without questioning the quality of so many 1st and 2nd cycle teachers, it seems to me that, in many cases and in many schools, teaching in these cycles does not aim at creating an interest in and the love of Mathematics, but rather at teaching all items in the curriculum. This does not have in mind that the great aims of Mathematics teaching are the development of reasoning and mathematical communication, as well as the training of the student in stating and solving problems, in using information technologies, in building mathematical models for reality, in understanding different modes of mathematical representation.

   Aims like these demand great commitment from the teachers, and above all they require that the teacher himself is deeply interested and devoted to the teaching and learning of Mathematics.

   In the case of Portugal, these conditions are not necessarily satisfied, as many 1st and 2nd cycle teachers have not had any mathematical training since 9th grade (in the 2nd cycle, the scientific training of Mathematics teachers has been very poor for quite some time. It's a bidisciplinary teaching group, involving Natural Sciences and Mathematics, so that many Mathematics teachers are trained in Biology or Geography, with little or no high-level mathematical training). On top of this, some of them may even have completed the 9th grade without a pass grade in Mathematics. Also, we cannot forget the harm done to the teaching of Mathematics by the hiring of 3rd cycle teachers from candidates with no degree in the subject. (The lack of Mathematics graduates led to the hiring of many 3rd cycle Mathematics teachers without a degree in Mathematics, while those with such a degree usually taught in secondary schools.) This means that the most serious problems in the teaching of Mathematics probably lie in the first school years, where

teacher training is often the critical factor in the whole teaching process;

8. The fourth factor relates to the poor command of Portuguese language by many students. To learn Mathematics, above all to be able to state and solve problems, language skills are required which involve the ability to understand readings and to express thoughts.

   Language learning is therefore a factor closely related to the learning of Mathematics. A recent study concluded that a large part of the failure in Mathematics follows from the poor command of the Portuguese language by many students. Here we see the importance of reading which, as stated in the OECD study "Reading for Change", is a decisive factor for success in education, above even the social, economic and cultural background of students;

9. A fifth factor has to do with the way the School Project promotes the teaching of Mathematics, as well as the organization and the work developed by the Mathematics teachers in the School. This is a relevant factor, related to the School leadership, and the incentives, control and assessment brought about by that leadership throughout the year.

   The teachers' scientific knowledge is a decisive factor to improve the learning of Mathematics, but if the school as a whole does not choose Mathematics as a subject requiring special efforts (specially because in most cases it's a subject in which results are poor and interest is low) the abilities of the teachers will not matter much.

   Mathematics is today, to many students and many families, a subject in which failure seems to pass from the parents to the children, and the latter often fall victim to the mentality of those who, on finishing the 9th grade, proclaim "Mathematics Never Again";

10. As a sixth factor we mention school organization and functioning, which together with the way students and their families look at the school also play a role in the shocking failure in Mathematics by our students.

    It seems to me crucial to consolidate an autonomy model in public schools which brings about greater responsibility of the leadership and increases the accountability to which all educational institutions must be subject. Along with is, it is also very important, to improve the way schools work and therefore student success, to bring the parents into the schools and thus eliminate some of the barriers which, in many cases, still exist between families and school leaders;

11. As we said before, teacher training and selection for the first school cycles are among the factors explaining poor teaching and learning of Mathematics. We believe that a great effort is equally necessary to improve the teaching of Mathematics in the 3rd and secondary cycles. This effort involves the initial training of teachers, which takes place at the Universities, where the courses must involve a scientific component duly qualified and assessed. (The elimination of the accreditation institute created in 1997 is a very troubling sign, which may mean the loss of quality control of teacher training courses);

12. The change in the Mathematics curriculum is traditionally considered as a measure, which might change the situation of the teaching of the subject. In the last 20 years countless reforms and changes were carried out in the curriculum. I honestly think (others more qualified may disagree) that the curriculum alone will not radically change the success indicators in Mathematics, or the lack of interest displayed by many students towards the subject.

    As proof of this there is the fact that many schools, public and private, have managed to create an atmosphere where the teaching of Mathematics is promoted, with significant rises in the numbers of students who begin to like the subject.

    The role of the teacher, the organization of the school and the way the school leaders face "the Mathematics problem", are much more decisive than the simple change or extension of the Mathematics curriculum.

    It should be said, nevertheless, that there surely are some aspects related to the curriculum that may be factors of change and improvement in the teaching of Mathematics. The most relevant of these have to do with the way the subject matter is divided by the successive years and the quality of some school textbooks (contrary to the heavy, grey and colourless "official textbooks" of the past, some of the current Mathematics textbooks have childish texts and images, as a sort of comic books where rigour is lacking and concepts are not clear);

13. Portugal has excellent Mathematics teachers. From the 1st cycle to the University we find countless success cases in the teaching of Mathematics throughout the country. Between the teacher who is able to instil the "love for numbers" into the 6-, 7- or 8-year-old child, and the researchers and university professors who do research and help train hundreds of masters and PhD's, there exist hundreds of qualified teachers who constitute the only way through which it will be possible to

solve the critical problem of improving the teaching of Mathematics in Portuguese schools.

Nothing will be achieved, however, if our students and their families do not understand that studying implies work, effort, dedication and sacrifice, for which they must be prepared. Mathematics is a subject with a structuring character in the education of an individual.

Much of the future of our country will depend on the work done in the schools, complementing the education by parents and families. And in the school a good fundamental education, specially in Mathematics, is surely one of the decisive factors for the development of a country wishing to base its future on human resources, on knowledge and on technology.

14. Universities will play a decisive role in any strategy to improve the teaching of Mathematics.

    Teacher training, the deepening of knowledge, the attraction of young people of great potential and the creation of a "critical mass" of researchers (as is being done in many Mathematics Departments of Portuguese Universities) are surely the best way for the Universities to be a sustainable basis for the improvement of the teaching of Mathematics. The rest will follow.

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